

REMARKS

Claims 1-26 are pending. Claims 1, 11, 24 and 26 have been amended merely for clarification and not limitation.

Entry of this amendment is proper under 37 C.F.R. § 1.116 as the amendments:

(a) place the application in condition for allowance for the reasons discussed herein; (b) do not raise any new issues that would require further consideration and/or search as the amendments merely amplify issues discussed throughout the prosecution; (c) do not present any additional claims without canceling a corresponding number of claims; and (d) place the application in better form for appeal, should an appeal be necessary. The amendments are necessary and were not earlier presented as they are in response to arguments raised in the final rejection. Entry of the Amendment is respectfully requested.

Reconsideration and allowance of the present application based on the following remarks are respectfully requested.

Claim Rejection – 35 USC § 102

Claims 1-26 are rejected under 35 U.S.C. 102(b) as being allegedly anticipated by Sakai *et al.* (US Pat. 5,925,887). Applicants respectfully traverse this rejection for at least the following reasons.

With respect to claims 11-12, the Office Action contends that Sakai *et al.* discloses a projection exposure apparatus comprising all structures set forth in the claims including at least one spot formation device for forming at least one spot of radiation from at least a portion of the projection beam such as a light blocking plate 21 having a central pinhole at the substrate plane or the transmissive mask 2 defining a spot or pinhole at the mask plane; and a sensor comprising a photodiode and CCD 22 for measuring a spatial variation in intensity of defocused radiation.

In response to the arguments filed January 2, 2003, the Office Action contends that Sakai *et al.* teaches a light blocking plate having a central pinhole, the CCD 22/radiation sensor which is disposed below the light blocking plate and is at a predetermined distance from the light blocking plate 21. The Office Action also contends that Sakai *et al.* teaches the pinhole of the light blocking plate is disposed at different positions within the imaging and thus the CCD 22/radiation sensor measures the spatial light intensity which corresponds to the light intensity distribution of diffraction light from the device pattern of the reticle 13.

Applicants agree that Sakai *et al.* teaches the radiation sensor CCD 22 measures the spatial light intensity which corresponds to the light intensity distribution of diffraction light from the device pattern of the reticle 13. Consequently, Sakai *et al.* does not teach or suggest that the radiation sensor measures a spatial variation in intensity of defocused radiation from the at least one spot, i.e., spot 21. Moreover Sakai *et al.* does not disclose, teach or suggest a pin-hole of a detector (such as a single photodetector or a CCD) at an out of focus position. In Sakai *et al.*, the pin-holes of the detectors are placed adjacent to an object, imaging, or a pupil plane and not at an out of focus position.

In contrast, claim 11 recites, *inter-alia*, “at least one spot formation device to form at least one spot of radiation from at least a portion of said projection beam in said apparatus; and at least one radiation sensor placed at an out of focus position with respect to said at least one spot, to measure a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof.”

As stated in the response filed January 2, 2003, with the use of the radiation sensor recited in claim 11, it becomes possible to measure the angular and spatial distribution of the projection system with greater accuracy and thus allowing, for example, to substantially reduce image anomalies of a projected pattern and allowing, for example, improving the accuracy of the positioning in registry of stacked layers of a device.

Consequently, Sakai *et al.* does not disclose, teach or suggest, *inter-alia*, “at least one spot formation device to form at least one spot of radiation from at least a portion of said projection beam in said apparatus; and at least one radiation sensor placed at an out of focus position with respect to said at least one spot, to measure a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof,” as recited in claim 11.

Similarly, claim 1 recites, *inter-alia*, “measuring, with at least one sensor placed at an out of focus position with respect to said spot, a spatial variation in intensity of defocused radiation from the spot or from an image of the spot.” Sakai *et al.* is silent about measuring spatial variation in intensity of defocused radiation from the spot or from an image of the spot. Accordingly, Sakai *et al.* does not disclose, teach or suggest the subject matter recited in claim 1.

Claim 24 contains all the limitations recited in claim 11. Therefore, Applicants submit that claim 24 is patentable for at least the reasons stated above.

Claim 26 recites, *inter-alia*, “measuring a spatial variation in intensity of defocused radiation from said spot with at least one sensor placed at an out of focus position with

respect to said spot, the at least one sensor being constructed and arranged to perform real time electronic analysis of an intensity distribution.” Sakai *et al.* is silent about measuring spatial variation in intensity of defocused radiation from the spot with at least one sensor, the at least one sensor being placed at an out of focus position with respect to the spot. Accordingly, Sakai *et al.* does not disclose, teach or suggest the subject matter recited in claim 26.

Therefore, Applicants respectfully submit that claims 1, 11, 24 and 26, and claims 2-10, 12-23 and 25 which are directly or indirectly dependent from one of the claims 1, 11, 24 and 26, are patentable and respectfully request that the rejection of claims 1-26 under § 102(b) be withdrawn.

Claims 1-3, 10-11, 13-15 and 26 are rejected under 35 U.S.C. 102(b) as being allegedly anticipated by Nishigori *et al.* (US Pat. 6,118,516). Applicants respectfully traverse this rejection for at least the following reasons.

The Office Action contends that Nishigori *et al.* discloses an exposure apparatus comprising all basic features of the instant claims including a transmissive reticle 9 defining a pinhole; a projection optical system 10, a substrate 11 and a sensor for measuring a spatial variation in exposure amount of defocused radiation from the at least one spot or an image thereof. Applicants respectfully disagree.

Contrary to the Office Action contention, Nishigori *et al.* does not disclose, teach or suggest a sensor for measuring a spatial variation in exposure amount of defocused radiation from the at least one spot or an image thereof. Moreover, Nishigori *et al.* does not disclose, teach or suggest the sensor is placed at an out of focus position with respect to the spot. In fact, the sensor 12 shown in Figure 1 of Nishigori *et al.* is mounted on a movable stage for holding the wafer 11. Nishigori *et al.* states that the sensor 12 is so disposed so that the light receiving surface thereof is placed substantially at the same level as the image plane of the reticle 9 (see col. 6, lines 9-15). Therefore, the sensor 12 is placed at position (wafer stage) where light is necessarily focused and measures the light distribution at this focused position. Sensor 12 does not measure a spatial distribution of defocused radiation. Furthermore, Nishigori *et al.* merely describes a method for scanning projection lithography apparatus and does not disclose teach or suggest anything regarding measuring an angular intensity distribution.

Consequently, Nishigori *et al.* does not disclose, teach or suggest "at least one radiation sensor placed at an out of focus position with respect to said at least one spot, to measure a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof," as recited in claim 11, and "measuring, with at least one sensor placed at an out of focus position with respect to said spot, a spatial variation in intensity of defocused radiation from the spot or from an image of the spot," as recited in claim 1.

Claim 24 contains all the limitations recited in claim 11. Therefore, Applicants submit that claim 24 is patentable for at least the reasons stated above.

Claim 26 recites, *inter-alia*, "measuring a spatial variation in intensity of defocused radiation from said spot with at least one sensor placed at an out of focus position with respect to said spot, the at least one sensor being constructed and arranged to perform real time electronic analysis of an intensity distribution."

As stated above, in Nishigori *et al.* the sensor 12 measures the distribution of light focused by the projection system 10. Accordingly, Nishigori *et al.* does not disclose, teach or suggest the subject matter recited in claim 26.

Therefore, Applicants respectfully submit that claims 1, 11 and 26, and claims 2-3, 10, and 13-15 which are directly or indirectly dependent from one of the claims 1, 11 and 26, are patentable and respectfully request that the rejection of claims 1-3, 1-11, 13-15 and 26 under § 102(b) be withdrawn.

Claims 1-26 are rejected under 35 U.S.C. 102(e) as being allegedly anticipated by Irie *et al.* (US Pat. 6,118,516). Applicants respectfully traverse this rejection for at least the following reasons.

With respect to claims 1-26, the Office Action contends that Irie *et al.* discloses an exposure apparatus and method comprising all structures set forth in the claims including at least one spot formation device for forming at least one spot of radiation from at least a portion of the projection beam such as a light plate 36 having a central pinhole at the substrate plane or the transmissive mask 2 defining a spot or pinhole at the mask plane; and a sensor 48-49 for measuring a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof.

In response to arguments filed January 2, 2003, the Office Action contends that Irie *et al.* teaches the sensor 49 which is used to measure the intensity distribution on the pupil plane FP of the projection optical system 3 of diffracted light emerging from the contact hole

pattern 2 and that due to the distortion of the projection optical system, the projection optical system 3 projects at least a slight degree of defocus light from reticle 46 onto the wafer. Applicants respectfully disagree.

Claim 11 recites, *inter-alia*, "at least one radiation sensor placed at an out of focus position with respect to said at least one spot, to measure a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof."

Applicants reiterate the arguments filed January 2, 2003. Specifically, the plate 36 in Irie *et al.* is merely a reference mark plate set on the wafer stage 13 (see Figure 4 and col. 15, lines 66-67 in Irie *et al.*) Accordingly, in Irie *et al.* the reference mark plate 36 being on the wafer stage 13, simply measures radiation which is not defocused because the projection system 3 (with pupil filter 4) projects, i.e. focuses, the light from the reticle 46 onto the wafer 5. If, as the Office Action contends, the projection optical system 3 projects a slight degree of defocus light from reticle 46 onto the wafer, the image of the reticle would be projected out of focus on the wafer and the image on the wafer would be blurred. This would be not acceptable in a lithography apparatus in which high imaging accuracy is sought. Moreover, even if the Office Action's position that there may be some slight degree of defocus is correct, which Applicants do not concede, Irie's detector is not placed in an out of focus position. In fact, Irie's detector is placed as close as possible to the wafer plane, i.e. the focal plane. Thus, Irie *et al.* teaches away from placing the radiation sensor at an out of focus position to measure a spatial variation in intensity of defocused radiation by placing the detector in the focal plane.

In contrast, the lithographic projection apparatus of claim 11 uses at least one spot formation device to form at least one spot of radiation from at least a portion of the projection beam in the apparatus; and at least one radiation sensor placed at an out of focus position with respect to the at least one spot, to measure a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof. This allows, for example, measuring the spatial as well as the angular intensity distribution of the radiation at the reticle and/or wafer level.

As stated in the response filed January 2, 2003, by using the radiation sensor recited in claim 11, properties of the performance of the projection system, such as angular dependent lens transmission can be measured. In addition, the spatial intensity distribution at a pupil of the projection system contains valuable information relating to alignment, performance and optimization of the lithographic apparatus. The spatial intensity distribution at a pupil of the

projection system is, in practice, very difficult to measure in situ and sufficiently rapidly. With the use of the radiation sensor recited in claim 11, it becomes possible measure to the angular and spatial distribution of the projection with greater accuracy and thus allowing, for example, to substantially reduce image anomalies of a projected pattern and allowing, for example, improving the accuracy of the positioning in registry of stacked layers of a device.

Consequently, Irie *et al.* does not disclose, teach or suggest, *inter-alia*, "at least one radiation sensor placed at an out of focus position with respect to said at least one spot, to measure a spatial variation in intensity of defocused radiation from the at least one spot or an image thereof," as recited in claim 11.

Similarly, claim 1 recites, *inter-alia*, "measuring, with at least one sensor placed at an out of focus position with respect to said spot, a spatial variation in intensity of defocused radiation from the spot or from an image of the spot."

In Irie *et al.*, the reference mark plate 36 is on the wafer stage 13. The reference mark plate 36 merely measures radiation which is not defocused because the projection system 3 (with pupil filter 4) projects, i.e. focuses, the light from the reticle 46 onto the wafer 5. The reference mark plate 36 is placed on the focus plane of the projection system 3 and thus not located at an out of focus position of the contact hole pattern 2. Accordingly, Irie *et al.* does not disclose, teach or suggest the subject matter recited in claim 1.

Claim 24 contains all the limitations recited in claim 11. Therefore, Applicants submit that claim 24 is patentable for at least the reasons stated above.

Claim 26 recites, *inter-alia*, "measuring a spatial variation in intensity of defocused radiation from said spot with at least one sensor placed at an out of focus position with respect to said spot, the at least one sensor being constructed and arranged to perform real time electronic analysis of an intensity distribution." In Irie *et al.* the light emerging from the contact hole pattern 2, i.e., the spot of radiation, is focused on the wafer plane or focus plane of the projection system 3 where the reference mark plate 36 is placed. Thus, the reference mark is not located at an out of focus position of the contact hole pattern 2. Accordingly, Irie *et al.* does not disclose, teach or suggest the subject matter recited in claim 26.

Therefore, Applicants respectfully submit that claims 1, 11, 24 and 26, and claims 2-10, 12-23 and 25 which are directly or indirectly dependent from one of the claims 1, 11, 24 and 26, are patentable and respectfully request that the rejection of claims 1-26 under § 102(e) be withdrawn.

CONCLUSION

In view of the foregoing, the claims are now believed to be in form for allowance, and such action is hereby solicited. If any point remains in issue which the Examiner feels may be best resolved through a personal or telephone interview, please contact the undersigned at the telephone number listed below.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,

PILLSBURY WINTHROP LLP

By: 

Robert C. Perez

Reg. No.: 39,328

Tel. No.: (703) 905-2159

Fax No.: (703) 905-2500

RCP/KG
1600 Tysons Boulevard
McLean, VA 22102
(703) 905-2000